

### JOINT PROJECT

## Carbon2Chem<sup>®</sup>

KEEPING CARBON  
IN THE LOOP



<sup>1</sup> Dr.-Ing. Barbara Zeidler-Fandrich, Head of Carbon2Chem<sup>®</sup> subproject "Synthesis Gas".

## L-III | GAS PURIFICATION AND GAS CONDITIONING

### CATALYTIC PROCESSES, THERMAL DESORPTION, AND SIMULATION

#### Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT

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#### Background

Within the Carbon2Chem<sup>®</sup> project, technologies are being developed to reduce CO<sub>2</sub> emissions at large industrial sites by using the emissions as a new source of raw materials for the chemical industry.

The focus lies on forming cross-industrial value creation chains and increasing energy efficiency by establishing cross-industrial networks.

This will be shown using the steel production site Duisburg/NRW as an example.

#### Aims

The aim of subproject L-III is to develop and implement gas purification and treatment technologies for steel mill gases.

The task of Fraunhofer UMSICHT is to develop catalytic deoxygenation that should be connected upstream of pressure swing adsorption. Pressure swing adsorption is used to provide hydrogen for catalytic processes. Fraunhofer UMSICHT also develops and simulates thermal desorption processes.



1 Front view high temperature fixed bed reactor for thermal deoxygenation.

## Tasks

Project duration 2020 to 2024

### Thermal deoxygenation

- Investigation of different catalysts and process conditions in a complex gas matrix

### Non-thermal plasma deoxygenation

- Investigation of different catalysts and process conditions in a non-thermal plasma

### Thermal adsorption and desorption

- Testing of the Electric Swing technology for the separation of minor components and materials from various steel mill gases

### Simulation of thermal adsorption and desorption

- Development of a deepened physical model to simulate adsorption and desorption processes

## Milestones

Project duration 2016 to 2020

### Thermal deoxygenation

- High-temperature fixed-bed reactor (artificial steel mill gas), metering system for minor components, MS analyzer, O<sub>2</sub> sensor

### Non-thermal plasma deoxygenation

- Coaxial volume DBD reactor with optional fixed bed (0.1 Nm<sup>3</sup>/h) gas metering and analysis for steel mill gases
- Gas dosing and analysis for steel mill gases

### Thermal adsorption and desorption

- Electric Swing Adsorption 6 Nm<sup>3</sup>/h (designed and built)

### Simulation of thermal adsorption and desorption

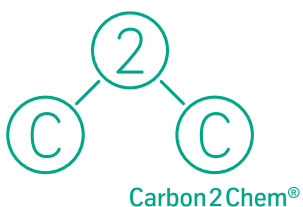
- Multiscale model developed
- Further development of the microscale model (consideration of individual particles)
- Verification and validation of the created model
- Implementation of multi-component adsorption isotherms

## Specific expertise

- Catalytic gas purification
- Gas purification using non-thermal plasma or plasma catalysis
- Adsorbents and adsorption processes
- Simulation of process engineering processes
- Construction and operation of process plants

## Further project partners in L-III

- Linde GmbH (coordination)
- thyssenkrupp Industrial Solutions AG
- Clariant Produkte GmbH
- Ruhr-Universität Bochum



## Further information

[www.umsicht.fraunhofer.de/carbon-cycle](http://www.umsicht.fraunhofer.de/carbon-cycle)

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